

# Thinking about Science and Christian Orthodox Beliefs: A Survey Study of Teacher Beliefs

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<p>William W. Cobern, Ph.D.* The Mallinson Institute for Science Education Western Michigan University 3245 Wood Hall Kalamazoo, MI 49008 Email: bill.cobern@wmich.edu</p> <p>Cathleen C. Loving, Ph.D. Department of Teaching, Learning &amp; Culture Texas A&amp;M University College Station, TX 77843-4232 Email: cloving@tamu.edu</p> <p>* Address correspondence to Dr. Cobern.</p>	<p>Edward B. Davis, Ph.D. Professor of the History of Science Messiah College Grantham, PA 17027 Email: tdavis@messiah.edu</p> <p>Jeff Terpstra, Ph.D. Department of Statistics Western Michigan University Kalamazoo, MI 49008 Email: Jeffrey.terpstra@wmich.edu</p>
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## Abstract

Since its origination in the late 19<sup>th</sup> Century, the warfare metaphor has been used to characterize the relationship between science and religion, especially orthodox Christianity. Though thoroughly discredited by historians of science, the ideological descendants of Thomas Huxley, who spoke of science in quasi-religious terms, have kept the warfare metaphor alive. On the other hand, there are substantial numbers of Christians who at least appear to oppose science given their high-profile opposition to the general theory of evolution. The purpose of the research reported in this paper was to examine this specific question: is anti-science sentiment associated with increasing orthodox Christian belief? Two validated, published instruments were used: *The Thinking about Science Survey Instrument* and the *Christian Fundamentalist Belief Scale*. The subjects for the study were 970 preservice elementary teachers. The analysis did not show that anti-science sentiment increases with increasing Christian belief. Subjects with strong Christian beliefs were found to be just as supportive of science, if not more so, than subjects with no Christian beliefs. The study concludes with a caution against projecting attitudes toward science “on the whole” based on attitudes specifically toward evolution.

Since its origination in the late 19<sup>th</sup> Century, the Warfare Metaphor has been used to characterize the relationship between science and religion, especially orthodox Christianity.<sup>1</sup> Though thoroughly discredited by historians of science, there are on the other hand, substantial numbers of American Christians who at least appear to oppose science given their high-profile opposition to the general theory of evolution.<sup>2</sup> The purpose of the research reported in this article was to examine the specific question: is anti-science sentiment characteristic of orthodox Christian belief?

## LITERATURE BACKGROUND

When people think of the history of science and religion, the Warfare Metaphor often comes to mind. Certainly, almost everyone working in any science or science-related area has heard the metaphor, the idea that the relationship between science and religion is ordinarily one of conflict, with science “winning” an historical “war” for ultimate truth. Judging from the literature, science educators and researchers are certainly aware of the metaphor and some even endorse it (e.g., Good 2001a; Slezak 2008). This perspective on the relationship between science and religion has Enlightenment roots, but most scholars today associate it primarily with two 19<sup>th</sup>-century Americans: chemist John William Draper, who wrote *History of the Conflict between Religion and Science* (1874), and the first president of Cornell University, Andrew Dickson White, who was (ironically) a trained historian, despite the dismal quality of his scholarship. White published several versions of the “warfare” idea, culminating in a two-volume work bearing the highly descriptive title, *A History of the Warfare of Science with Theology in Christendom* (1896/1960). In this book he catalogued numerous episodes of alleged “conflict” between Christian theology and science, supporting his overall conclusion that the historical record is one of unremitting conflict between two fundamentally opposed ways of understanding the world.

White’s book remains in print more than one hundred years later, and it is also available from several internet sites—including one called “atheism.about.com” and another called “infidels.org”<sup>3</sup>— which suggests one reason why such a profoundly unreliable book is still popular in certain circles. What is surprising is that some members of the science and science education communities seem to think that White wrote the final chapter on this topic, that he did the job properly, and that no better history of science and religion has been done since. As a result, in contemporary events in which science and religion often seem to have different goals, the events are often immediately interpreted in light of the Warfare Metaphor.

The truth about White and the Warfare Metaphor is quite the opposite. Contemporary historians of science have very effectively discredited the Warfare Metaphor as an accurate description of the relationship between science and religion (Brooke 1991; Brooke & Cantor 2000, Livingstone 1993; Numbers 1992 & 2009; Rudwick 1981). One can learn something rather interesting from this literature, such as that the “conflict icons,” Galileo and Darwin, do not represent simple, unproblematic cases of religion attempting to oppress science. One would also learn that religious beliefs have often provided powerful motivation for doing science, and that some fundamental attitudes, assumptions, and theories in modern science are closely related to the religious beliefs of the scientists who held them or created them. These points have been documented repeatedly by many leading historians of science, to such an extent that it is no longer possible for informed scholars to take White’s book seriously as a work of historical scholarship.

Simply put, Andrew Dickson White was not a very good historian. Of the dozens of examples we could cite, we offer for consideration a remarkably imaginative paragraph in which White quotes “statements” about astronomy by two of the most famous Protestant theologians who have ever lived, John Calvin and John Wesley.

While Lutheranism was thus condemning the theory of the earth's movement, other branches of the Protestant Church did not remain behind. Calvin took the lead, in his *Commentary on Genesis*, by condemning all who asserted that the earth is not at the centre of the universe. He clinched the matter by the usual reference to the first verse of the ninety-third Psalm, and asked, ‘Who will venture to place the authority of Copernicus above that of the Holy Spirit?’... and even John Wesley declared the new ideas to ‘tend toward infidelity.’ (White 1896, p. 73)

These statements have become famous examples of the “obscurantism” of theologians when confronted with scientific truth, yet nothing like either “statement” was ever uttered.

The only part of this passage resembling the truth is the opening sentence: Martin Luther found the earth’s motion incredible and unbiblical, and most 16<sup>th</sup>-century Lutherans agreed with him. Nevertheless, Lutheran astronomers Georg Joachim Rheticus, Erasmus Reinhold, and Johannes Kepler were crucial to the introduction, dissemination, and eventual acceptance of Copernican astronomy, while Luther’s leading disciple, Philipp Melanchthon, even viewed Copernicus as a moderate reformer similar to Melanchthon himself in this respect (Westman 1975 & 1986; Gingerich 2002). White then attributes to Calvin a quotation that is totally false, yet Bertrand Russell, Thomas Kuhn, and many others have subsequently continued the error.<sup>4</sup> Finally, as if for an encore, White quotes John Wesley entirely out of context, directly implying that Wesley opposed heliocentrism when actually he fully accepted it.<sup>5, 6</sup>

Despite the incompetence of his scholarship, White’s book is still taken as historical support for an antagonism made famous by Thomas Huxley (1893), known as “Darwin’s Bulldog,” who sometimes spoke of science in quasi-religious terms. Huxley’s ideological descendants have kept the Warfare Metaphor alive – or at least its spirit (Dawkins 1986; Shermer 2002). These include contributors to the literature on science education (Good 2001a & b; Mahner & Bunge 1996; Martin 1997; Slezak 2008), which is somewhat understandable given the persistence of anti-evolution sentiment and the high-profile opposition of creationists—and indeed the ranks of anti-evolutionists in America are overwhelmingly Evangelical (Mazur 2004; McIver 1989), and Evangelicals compose a significant percentage of orthodox Christianity in America—and their numbers are not insignificant.<sup>7</sup>

There are many polling agents in the USA. There is a great deal of polling data regarding the religious beliefs and practices of Americans; and the numbers across various polls are fairly congruent. However, how questions are phrased can yield different data (Bishop 2009). What questions asked also can yield differences, and the data on Evangelicals is a case in point (Newport 2005). The number of self-identified Evangelicals tends to run higher than counts of Evangelicals based on responses to doctrinal questions. For example, Protestant church pollster George Barna (Barna Research Group 2002) finds five discernible religious segments in the American public, three of which are associated with Christianity. See Table 1.

Table 1. Five Areas of American Belief

Areas of Faith	%
Evangelicals	8
Born Again Christians, but not Evangelicals	33
Notional Christians	44
Other Faiths	7
Agnostic/Atheist	8

The Barna percentage for Evangelicals is smaller than what for example the Gallup Poll provides (Newport, 2005) because Barna uses much more restrictive definitions:

"Born again Christians" were defined in these surveys as people who said they have made a personal commitment to Jesus Christ that is still important in their life today and who also indicated they believe that when they die they will go to Heaven because they had confessed their sins and had accepted Jesus Christ as their savior. *Respondents were not asked to describe themselves as "born again."*

"Evangelicals" are a subset of born again Christians in Barna surveys. In addition to meeting the born again criteria, evangelicals also meet seven other conditions. Those include saying their faith is very important in their life today; believing they have a personal responsibility to share their religious beliefs about Christ with non-Christians; believing that Satan exists; believing that eternal salvation is possible only through grace, not works; believing that Jesus Christ lived a sinless life on earth; and describing God as the all-knowing, all-powerful, perfect deity who created the universe and still rules it today. *Being classified as an evangelical has no relationship to church attendance or the denominational affiliation of the church they attend.* Respondents were not asked to describe themselves as "evangelical." (Barna Research Group 2002; emphases added)

Combining these groups yields a percentage of 41, which is similar to Gallup figures from its polling with less restrictive definitions. Although the questions asked have a Protestant tinge in that they are Bible-centered and not about ecclesiology, Gallup polls indicate a “surprisingly high percentage of Catholics (19%) say they are born again or evangelical” (Newport 2005).<sup>8</sup> The significance of these figures is simply that the presence of orthodox Christianity in the American population is substantial.<sup>9, 10</sup> Undoubtedly the sheer size of this presence contributes to the concern some have about anti-evolution sentiment. However, for those having embraced the Warfare Metaphor, to be anti-evolution is to be anti-science. As already noted, our interest has not been anti-evolutionism *per se* but the broader question of whether opposition to science is characteristic of orthodox Christian belief, which is the suggestion of Dawkins (2006), Dennett (2007), Good (2001a & b), Mahner and Bunge (1996), Martin (1997), Slezak (2008), among others.

## METHOD

The study used a survey method to investigate the valuation of science amongst subjects generally supportive of religion and amongst those specifically holding to orthodox Christian belief. Well-constructed surveys with a sample that has defensible characteristics and of adequate size, allows one to make sound generalizations about a broader population though many specific questions remain unanswered.

### Instrumentation

Valuation of science was analyzed using the *Thinking about Science Survey Instrument-v2* (TSSI-v2), and we are reporting the fourth study in a series of TSSI studies (Cobern & Loving 2002a & b, and 2006; Sulikowski, Loving & Cobern, 2003; Titrek & Cobern in press). The TSSI addresses the broad relationship of science to nine social and cultural categories: 1) Epistemology, 2) Science & the Economy, 3) Science & the Environment, 4) Public Regulation

of Science, 5) Science & Public Health, 6) Science & Religion, 7) Science & Aesthetics, 8) Science, Race & Gender, and 9) Science for All. (See Tables 2 & 3)

Each category is composed of items that either defend science or object to science. The categories are not intended to represent an authoritative scientific worldview (Cobern, 1991), but a scientific worldview version commonly found in both the popular media and the popular literatures of science and science education. We refer to this public image as the *Model*. Subjects respond to the survey items on a scale of one to five. The “1” is labeled “strongly disagree.” The “3” is labeled “uncertain,” and the “5” is labeled “strongly agree.” Category means and medians are calculated for each individual on the basis of item responses and are used as the analysis variables. Mean/medians of about “4” and “5” for the categories indicate agreement with the *Model*. Moreover, a category mean/median of “5” for all nine categories would be indicative of scientific thinking. On the other hand, scores of “2” and “1” for the categories indicate disagreement with the *Model*; and a category mean/median of “1” for all nine categories would be indicative of anti-science thinking. Based on the data, profiles are developed with respect to the categories of the *Model*. Category mean/medians based on the composite of category items are calculated to form the profiles (see Cobern & Loving, 2002a).

Subsequent to the original TSSI studies, items composing the categories of Science & the Environment, Science & Religion, and Science & Aesthetics were redesigned to improve internal consistency. Revised items were trialed with 30 preservice elementary teachers. The items showing the greatest internal consistency within each of the three categories were retained.

Table 2. The *Model*: A Common Image of Science

#	Category	Category Description
1	<b>Epistemology</b>	Science is a superior, exemplary form of knowledge that produces highly reliable and objective knowledge about the real world. (Feynman 1995; Gross & Levitt 1993; Monod 1971)
2	<b>Science &amp; the Economy</b>	Modern industrial, commercial, and information-based economies depend on scientific developments for increasing production, wealth and general public welfare. (Alpert 2000; Hurd 1989)
3	<b>Science &amp; the Environment</b>	Science is necessary for the discovery, development, and conservation and protection of natural resources and the environment in general. (Polkinghorne 1996)
4	<b>Public Policy &amp; Science</b>	Science acts in the public interest. Science should thus be supported by public funds, however, the science community is more than capable of policing scientific activity. (Gross & Levitt 1993)
5	<b>Science &amp; Public Health</b>	The conquering of disease and physical affliction and the great advances in public health are made possible by science and will not continue without science. (Clark 1989)
6	<b>Science &amp; Religion</b>	Science is neutral with regard to religion except that the importance of science is such that science must be protected from the intrusive activities of some religion. (Dawkins 2000; Gould 1987 & 1997; Larson & Witham 1998; NAS 2008)
7	<b>Science &amp; Aesthetics</b>	There is a beauty to science. Indeed, “elegance” is often required of scientific ideas. Scientists are often passionate about their work but the work of science best proceeds on the basis of objective reason and empiricism. (Dawkins 2000; Polkinghorne 1996; Shlain 1991)
8	<b>Science, Race &amp; Gender</b>	Science is an “equal opportunity employer.” Race, gender and other personal factors are irrelevant in science.
9	<b>Science for All</b>	The importance of science is such that it should be taught at all levels of schooling. Every citizen should have attained at least a minimal level of science literacy. (AAAS 1990)

Table 3. Revised TSSI Items

<b>Category 1: Epistemology (EPIST)</b>
Scientific knowledge is the most objective form of knowledge.
We can be certain that scientific knowledge is reliable.
The methods of science are the most reliable source of true, factual knowledge.
Science is the best source of reliable knowledge.
Scientific knowledge is the truest form of knowledge.
Alpha = 0.7475
<b>Category 2: Science &amp; the Economy (ECON)</b>
Science helps develop our natural resources such as coal, gas, oil, and solar energy.
Scientific knowledge is useful in keeping our national economy competitive in today's world.
There are many good things we can do today because of scientific knowledge.
The development of our natural resources, such as coal, gas, oil, solar energy, is dependent upon having adequate scientific knowledge.
Scientific knowledge is useful for only a few people. (Scored in reverse)
Developing new scientific knowledge is very important for keeping our country economically competitive in today's world.
Scientific knowledge is useful.
Alpha = 0.7528
<b>Category 3: Science &amp; the Environment (ENVIR)</b>
Science plays a key role in the conservation of our environment.
Science plays a key role in the protection of our environment.
Science can help us preserve our natural environment and natural resources.
Without science we will not be able to preserve our natural environment and natural resources.
Science contributes important knowledge about our natural environment.
Alpha = 0.7037
<b>Category 4: Public Regulation of Science (POLY)</b>
There is little need for the legal regulation of scientific research.
Scientists should not be allowed to research anything they wish. (Scored in reverse)
Scientific research should be carefully regulated by law. (Scored in reverse)
Alpha = 0.7757
<b>Category 5: Science &amp; Public Health (HEAL)</b>
Scientific research makes important contributions to medicine and the improvement of public health.
Scientific knowledge contributes little to good health. (Scored in reverse)
Alpha = 0.5652
<b>Category 6: Science &amp; Religion (RELIG)</b>
The discoveries of science consistently rule out the claims of religion.
When scientific and religious descriptions of natural phenomena conflict, the scientific description should have the clear priority.
There is little common ground on which science and religion can meet.
The more humans learn scientifically about the natural world, the less reason they have for religion.
If a natural phenomenon can be described scientifically in natural "cause and effect" categories, then any religious description of that phenomenon must be excluded.
Scientific understanding of natural phenomena has made impossible any belief in the supernatural work of a deity.
Alpha = 0.7523
<b>Category 7: Science &amp; Aesthetics (BEAUT)</b>
Scientific explanations tend to spoil the beauty of nature. (Scored in reverse)
It is more important for a person to learn about science than it is to learn about the arts.
It is more important for a person to learn about the arts than it is to learn about science. (Scored in reverse)
Alpha = 0.5209
<b>Category 8: Science, Race &amp; Gender (RACE)</b>
Women are welcome in science just as much as men are.
The scientific community is mostly dominated by white men and is often unfriendly to minority people. (Scored in reverse)
African Americans and other minority people are just as welcome in the scientific community as are white people.
The scientific community is mostly dominated by men and is often unfriendly to women. (Scored in reverse)
Alpha = 0.7686
<b>Category 9: Science for All (For-All)</b>
Students should not be forced to take science courses at the university. (Scored in reverse)
Science should not be made an important subject for the elementary school grades. (Scored in reverse)
Understanding science is a good thing for everyone.
All students should study science during the secondary school grade levels.
Most people really do not need to know very much science. (Scored in reverse)
Even at the university level all students should study at least some science.
Science should be taught at all school grade levels.
Alpha = 0.8031

For a cursory indication of science interest, students are asked to respond to the following question: Based on all your experiences with school science, is science a subject you like? The poles of the 5-point response range are marked “dislike” for the number one and “like very much” for the number five. The underlying assumption is that a valid indicator of science interest ties interest to a particular science event or science activity rather than leaving the question open-ended. In our case the particular events are the science courses of the elementary teacher preparation program at a large Midwestern university. Since these courses were specifically designed to teach scientific processes and concepts, our opinion is that for those students who have had these courses, these courses make a good referent with respect to how interesting one finds science. This cursory indicator suffices for our purposes, as we are only interested in the general categories (i.e., more science interest, less science interest) in which a person might fall. This procedure was followed in Cobern & Loving (2002a & b, 2006).

For orthodox Christian belief, we used a published instrument called the Christian Fundamentalist<sup>11</sup> Belief Scale (CFBS, see Table 4) by Gibson & Frances (1996).

Table 4. Christian Fundamentalist Belief Scale (CFBS)

1. I believe that God made the world in six days and rested on the seventh.
2. I believe that the Bible is the word of God.
3. I believe that Jesus Christ was born of a virgin.
4. I believe that Jesus Christ will return to earth some day.
5. I believe in hell.
6. I believe that God judges what I do and say.
7. I believe that Jesus Christ died to save me.
8. I believe that Jesus Christ changed real water into real wine.
9. I believe that Jesus Christ walked on water.
10. I believe that Jesus Christ was the Son of God.
11. I believe that God is controlling every bit of our lives.
12. I believe that Jesus Christ really rose from the dead.

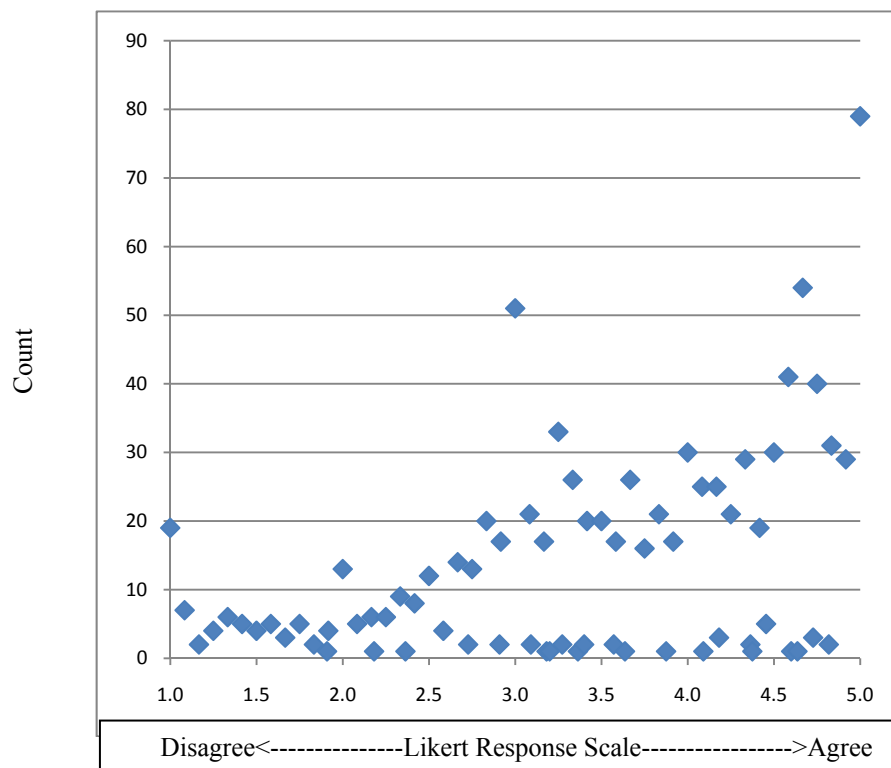
As noted earlier, asking people about their religion can involve various questions and can be directed toward either religious beliefs or practices. Major pollsters, however, typically use very few questions because the way modern polling is done one has each subject’s attention for only a few minutes at best.<sup>12</sup> We had no such time restraint and therefore could use an instrument that focused on multiple, core Christian beliefs. For this purpose, we chose the CFBS survey. Its content corresponds well with the definitions used by Barna (Barna Research Group 2002) and The Pew Forum on Religion & Public Life (2008a). Moreover, with the exception of items one and eleven,<sup>13</sup> the CFBS comports well with Catholic and Eastern Orthodox doctrine on basic Christian belief. CFBS was theoretically grounded in the field of religious studies by Gibson & Frances (1996) who reported a Cronbach’s alpha of 0.92 for the CFBS with a sample of 866 Scottish adolescents. We report the same alpha value from our data. As with the TSSI items, subjects respond to the CFBS items on a scale of one to five, from which a CFBS mean and median are calculated for each individual and used as an analysis variable.

## Subjects

Between 1997 and 2008, we collected data from 1640 preservice elementary teachers at a Midwestern university using the TSSI as a way to track student interest in science for curriculum and instruction purposes. From 2002 to 2008, the twelve items of the CFBS were interspersed with the TSSI items, again for curricular purposes. We mined this data base for the current study in the belief that elementary teachers make good subjects for our research questions because they are much like the educated public at large (Losh 2009, makes a similar claim). They are well educated in general but not greatly science-educated. In addition to their critical role in the education of children, elementary teachers are an interesting group for examining public belief about science with respect to other important ideas in modern American society.

Students in an upper level elementary science methods course were asked to voluntarily take our survey and virtually all students participated. The subjects were either seniors or second-semester juniors in a degree program that includes an elementary science methods course and four science content courses. The student population was typical for an elementary teacher certification program. The vast majority were between the ages of 20 and 35. Most of the students were women (~83%). A few students were non-traditional older students. Fewer than 10% of the students were persons of color. With regard to ACT scores and grades in general education, university required courses, the students compared very well with the rest of the university. The majority of the students at this university come from regions of the USA where there are high percentages of orthodox Christians. The results from 970 subjects who completed the CFBS bore this out (mean = 3.7/median = 3.9). The frequency distribution in Figure 2 is visibly more concentrated in the affirmative direction.

Figure 2. Frequency Distribution of CFBS Means



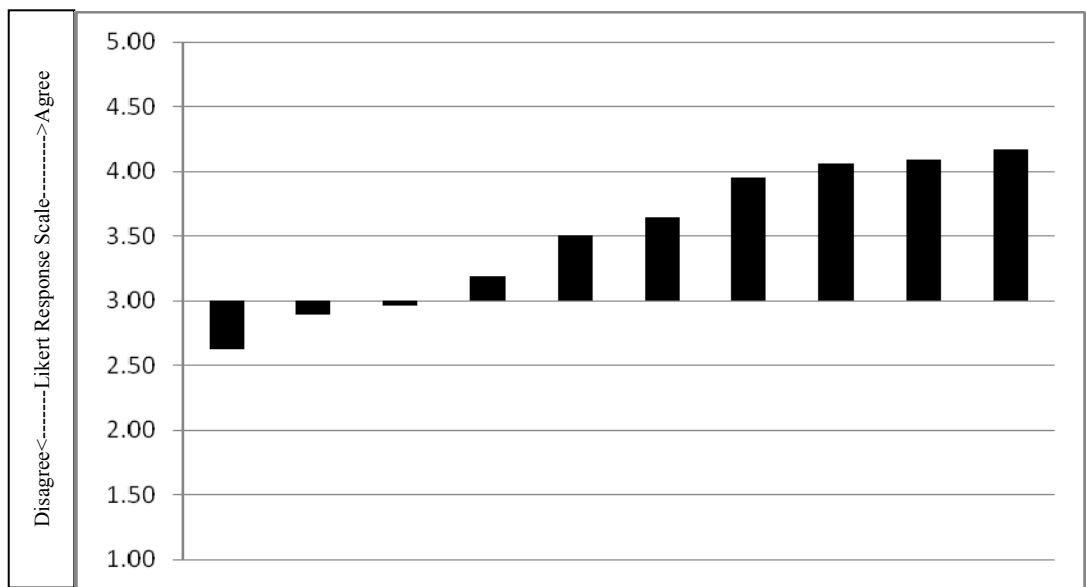


## Discussion of Findings

### *Is anti-science sentiment associated with supportive views of religion?*

The purpose of the research reported in this paper was to examine whether anti-science sentiment (measured as valuation of science) is associated with supportive views of religion; and more specifically to examine whether anti-science sentiment is correlated with orthodox Christian belief. Given the exploratory nature of the study, we decided on running two-sided correlation tests. Specifically, we address the first question by looking at the correlations between eight TSSI categories plus Interest in Science and the TSSI category on Science & Religion. These data provide the background for our first research question as to whether anti-science sentiment is associated with supportive views of religion. The data would suggest such an association if there were significant positive correlations between the mean for the Science & Religion category the other categories, that is, less supportive views of religion (high Science & Religion mean) would be associated with more supportive views of science. This means are plotted in Figure 3.

Figure 3: TSSI Category Correlations with the Science & Religion Category for 1997-2008 Data<sup>14</sup>



	Relig	Epist	Intrst	Race	Poly	Aesth	Envir	Econ	Heal	For-All
Mean	2.63	2.89	2.96	3.19	3.51	3.65	3.95	4.06	4.09	4.17
Median	2.75	2.90	3.00	3.25	3.75	4.00	4.00	4.00	4.00	4.25
r		0.336	-0.126	-0.029	0.274	-0.031	-0.074	-0.090	-0.147	-0.079
sig (2-tailed)		0.000	0.000	0.239	0.000	0.206	0.003	0.000	0.000	0.001
N	1635	1639	1570	1640	1639	1639	1640	1639	1639	1640

Relig = Science & Religion  
 Epist = Epistemology  
 Intrst = Interest in Science  
 Race = Science, Race & Gender  
 Poly = Public Regulation of Science

Aesth = Science & Aesthetics  
 Envir = Science & the Environment  
 Econ = Science & the Economy  
 Heal = Science & Public Health  
 For-All = Science for All

We consider the *Model* is affirmed for six of the categories where the mean equals or exceeds 3.50 and ambiguous for three categories where the means fall between 2.50 and 3.50.

None of the category means or medians fall below 2.50, including the Science & Religion category. The subjects value the idea that science should be taught at most grade levels if not all,<sup>15</sup> that science is important in a positive way to public health, the economy, and the environment, and that while science cannot be supplanted by the arts neither does science spoil our aesthetic appreciation of nature. Neither are the subjects inclined to think that scientific research requires much public regulation. The subjects are less sanguine about Science, Race & Gender, Epistemology, and Science & Religion. These category means along with the mean for Interest fall well within the zone of ambiguity. These findings cannot be surprising. The general high regard for science is consistent with other findings that Americans by and large are supportive of science (The Pew Research Center for the People & the Press, 2009). The ambiguous view of science vis-à-vis religion and epistemology is expected given the highly religious nature of the American populace. The ambiguity on Science, Race & Gender very likely reflects a long-standing concern in American education and politics that ethnic and gender under representation in the sciences be addressed. The median for interest in science is exactly 3.00; yet the median for the category on the importance of teaching science is 4.25, which suggests that science is important and it should be taught at school, but not that science is necessarily of interest to individuals. Given that none of the subjects is a science major, or science teaching specialist, this finding also seems hardly surprising.

These data provide the background for our first research question as to whether anti-science sentiment is associated with supportive views of religion. Again, the data would suggest such an association if there were significant positive correlations between the mean for the Science & Religion category and the other categories, that is, less supportive views of religion (high Science & Religion mean) would be associated with more supportive views of science. To the contrary, the correlations between the Science & Religion category mean and the means for each of the other categories and Interest are all very small, even though several of the correlation values are statistically significant at the 0.006 level (this level corresponds to a Bonferroni correction and assures us that the probability of making at least one Type I error is no more than 0.05) but the effect sizes are negligible<sup>16</sup> (Figure 3). Furthermore, note that seven of the nine correlations are negative, which is opposite of what the *Model* would predict. We would not wish to make much of any of the significant correlations given that the effect sizes are small, but we do note that the two positive correlations with Science & Religion are Epistemology and the Public Regulation of Science. This makes sense as it is unlikely that people strongly supportive of religion (low Science & Religion mean) would also hold the contrary opinion that scientific knowledge is superior to all other. It also makes sense that people strongly supportive of religion are also more supportive of the public regulation of science given the strong religious-based opposition to embryonic stem cell research.

Because this data ranges over an eleven year period, one would want to know if there is any consistent change with time. One would expect a certain fluctuation of means over the years merely by virtue of individual differences of subjects. However, a consistent increase or decrease with time would be indicative of more profound changes in the populace. We examine this point by looking at the correlations between year and category means to see if category means have generally risen or declined over the eleven year period of the data (Table 5).

Table 5: Correlations between Category Means and Year (1997-2008)

	Relig	Epist	Intrst	Race	Poly	Aesth	Envir	Econ	Heal	For_All
Pearson Correlation	<b>-0.197</b>	<b>0.105</b>	<b>0.224</b>	<b>0.138</b>	<b>-0.576</b>	<b>-0.075</b>	<b>0.293</b>	<b>0.159</b>	<b>0.140</b>	0.012
Sig. (2-tailed)	<b>.000</b>	<b>.000</b>	<b>.000</b>	<b>.000</b>	<b>.000</b>	<b>.003</b>	<b>.000</b>	<b>.000</b>	<b>.000</b>	.638
N	<b>1635</b>	<b>1639</b>	<b>1570</b>	<b>1640</b>	<b>1639</b>	<b>1639</b>	<b>1640</b>	<b>1639</b>	<b>1639</b>	1640

Relig	=	Science & Religion	Aesth	=	Science & Aesthetics
Epist	=	Epistemology	Envir	=	Science & the Environment
Intrst	=	Interest in Science	Econ	=	Science & the Economy
Race	=	Science, Race & Gender	Heal	=	Science & Public Health
Poly	=	Public Regulation of Science	For-All	=	Science for All

All but one of the correlations is statistically significant at the 0.005 (equal to 0.05/10 via the Bonferroni correction) but the correlations are also very low and they are mixed (some positive; some negative). The one category where the effect size is high enough to draw one's attention is the Public Regulation of Science. The negative correlation value indicates that subjects taking the survey in the later years had lower category means for the Public Regulation of Science. Though beyond the purpose of the present study, one speculation as noted above is that the high visibility of embryonic stem cell research debates in the latter part of this period may be reflected in a public concern over *under* regulated science (see Evans, Zanjani, & Kelly 2002; Pardo & Calvo 2008). As to our current research, we find sufficient stability of data across years for our purposes and for our conclusion that supportive views on religion are not indicative of anti-science sentiment.

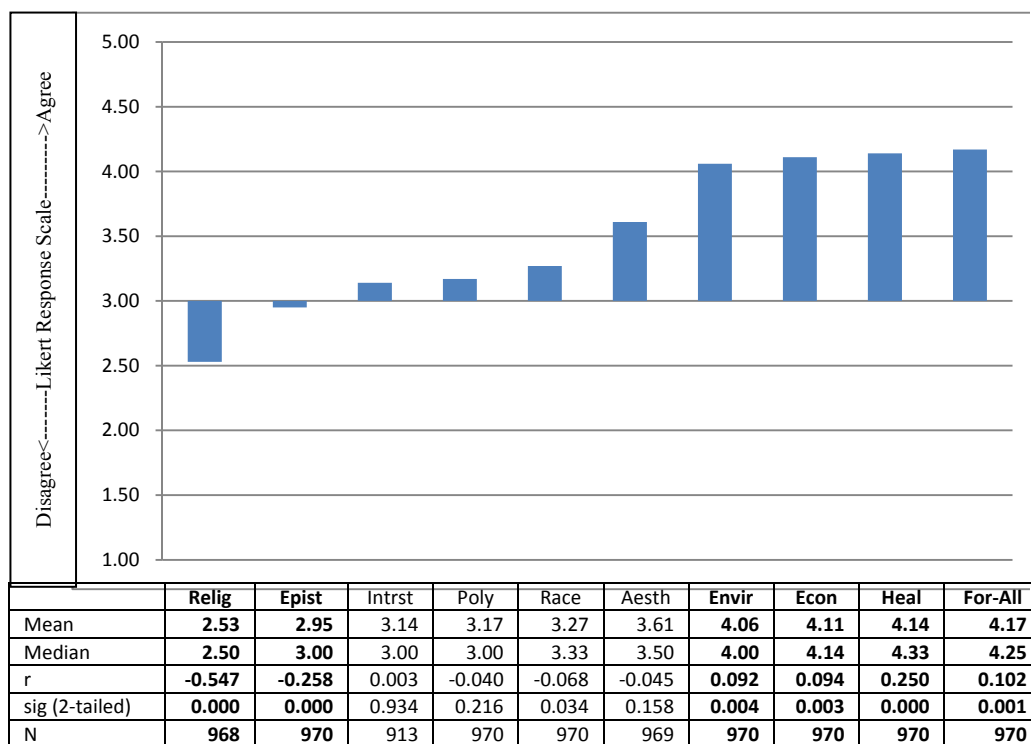
#### *Is anti-science sentiment correlated with orthodox Christian belief?*

Our second research question asks whether anti-science sentiment (measured as valuation of science) is associated specifically with orthodox Christian belief (measured by the CFBS). Based on the *Model*, anti-science sentiment would be indicated by positive correlation values between the categories of the *Model* and CFBS means. Hence, we address the question by looking at the correlations between nine TSSI category means (including the Interest in Science means) and the CFBS means (Figure 4). Six of the ten correlations are statistically significant at the 0.005 (equal to 0.05/10 via the Bonferroni correction) level and as in Figure 3, most of the effect sizes are small. The correlations are also mixed (four positive; two negative). The relatively strong negative correlation between CFBS means and the Science & Religion category means are to be expected. The fact that this particular correlation (-0.547) is not even stronger indicates that many subjects not holding to Christian orthodoxy are nonetheless supportive of religion vis-à-vis science. Therefore, the data provides little evidence that anti-science sentiment is correlated with orthodox Christian beliefs. The data also suggests that with the more restrictive filter of the CFBS there is still no indication that anti-science sentiment is prevalent amongst these subjects.

The data thus indicates that supportive views on religion (generally) and Christian orthodoxy (specifically) comport well with support of science especially with respect to science education for all, public health, the economy, aesthetics, and the environment. In these areas the subjects are consistent with the *Model*. Subjects demur somewhat from the *Model* over equity, policy, personal interest in science, and epistemology. They dissent from the *Model* when it comes to the superiority of science over religion. What one finds then is that all subjects show

support for science although it is a qualified support—actually not unlike scientists (see Cobern & Loving, 2002a; Ecklund, et al., 2009).

Figure 4: Interest in Science and TSSI Category Correlations with the CFBS Data (2002-2008)



Relig = Science & Religion  
 Epist = Epistemology  
 Intrst = Interest in Science  
 Poly = Public Regulation of Science  
 Race = Science, Race & Gender

Aesth = Science & Aesthetics  
 Envir = Science & the Environment  
 Econ = Science & the Economy  
 Heal = Science & Public Health  
 For-All = Science for All

### *Are Philosophical Naturalists more supportive of science than Christian Fundamentalists?*

Finally we turn to the question of those subjects most likely to reject evolution, the Christian Fundamentalists. As noted above, the items of the CFBS comport well with Christian orthodoxy except for items one and eleven (Table 4). Many orthodox Christians will have some reservations about item eleven and many will reject item one. Item one, which is of considerable relevance to science, would be affirmed by the vast majority of fundamentalist Christians. This is the item that reads: “I believe that God made the world in six days and rested on the seventh.” Affirming this item precludes any acceptance of evolution. Is opposition to evolution tantamount to opposition to science? We sought to address this question by finding a way to identify Christian Fundamentalists in the data set and then to compare their TSSI category scores with subjects in the data set that are arguably their polar opposites, the Philosophical Naturalists (Cobern, 2008). For example, a philosophical naturalist will very likely affirm the TSSI item: “The discoveries of science consistently rule out claims of religion.” Given a prima facie case that Christian Fundamentalists and Philosophical Naturalists will have diametrically opposite responses to these two items, we filtered the data base as follows. We identified 96 Fundamentalists as those subjects scoring “I believe that God made the world in six days and

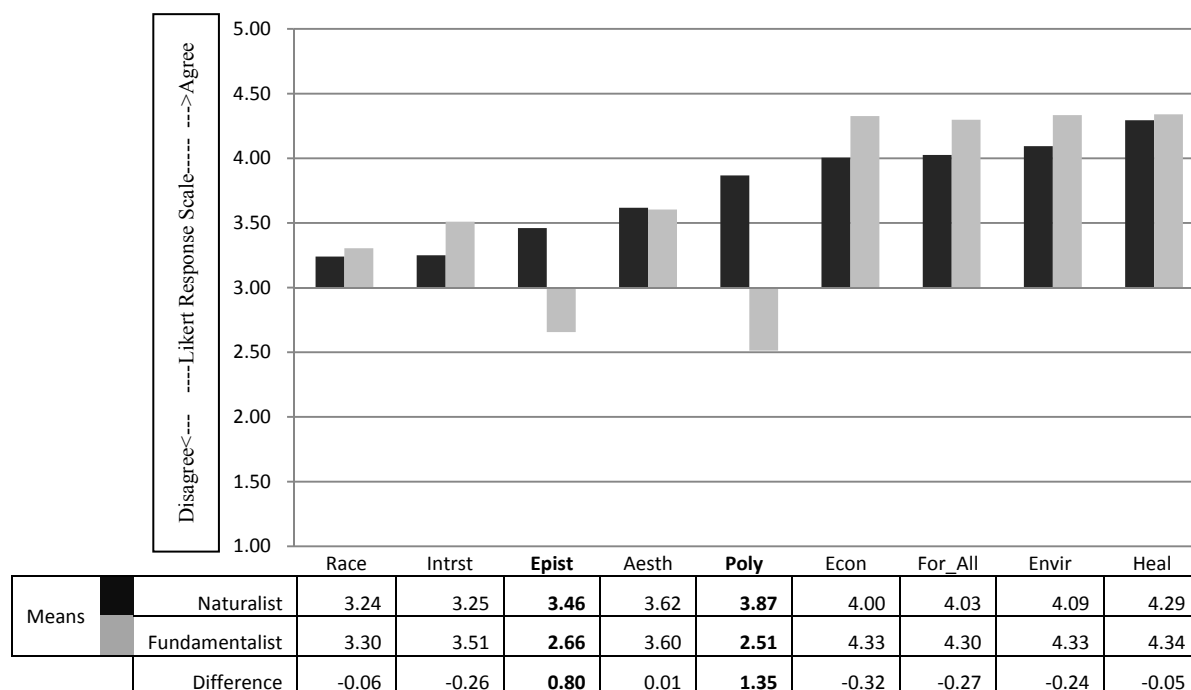
rested on the seventh” with a 5 (strongest acceptance), *and* scoring “The discoveries of science consistently rule out claims of religion” with a 1 (strongest rejection). We identified 17 Philosophical Naturalists as those subjects scoring “I believe that God made the world in six days and rested on the seventh” with a 1 (strongest rejection), *and* scoring “The discoveries of science consistently rule out claims of religion” with a 5 (strongest acceptance). The category means for each group were then analyzed with a t-test shown in Table 6. We used a 1-tailed p-value test given that we address the question, “are philosophical naturalists *more* supportive of science than Christian fundamentalists?” Positive mean differences support a “yes” response to the question. Applying the Bonferroni correction, p-values are judged statistically significant if less than 0.006. Figure 5 presents a graphical image of the means for the two side by side.<sup>17</sup>

Table 6. T-test for Independent Samples: Philosophical Naturalism and Christian Fundamentalism

		Sig. (1- tailed)	Mean Diff	Std. Error Diff	Lower	Upper
Interest	Equal variances assumed	0.788	-0.26	0.325	-0.906	0.384
<b>Epist</b>	Equal variances assumed	<b>0.000</b>	<b>0.80</b>	0.201	0.407	1.202
Econ	Equal variances not assumed	0.870	-0.32	0.278	-0.906	0.262
Environ	Equal variances not assumed	0.762	-0.24	0.328	-0.931	0.453
<b>Poly</b>	Equal variances assumed	<b>0.000</b>	<b>1.35</b>	0.239	0.881	1.828
Heal	Equal variances assumed	0.581	-0.05	0.225	-0.492	0.400
Beaut	Equal variances assumed	0.476	0.01	0.219	-0.420	0.447
Race	Equal variances assumed	0.599	-0.06	0.253	-0.566	0.438
For_All	Equal variances not assumed	0.853	-0.27	0.252	-0.803	0.258

The results are that two of nine differences are statistically significant: Epistemology and the Public Regulation of Science. Christian Fundamentalists are much more inclined to favor the regulation of scientific research. The Philosophical Naturalists are not. Christian Fundamentalists are not as inclined to accept the epistemological superiority of science in contrast to the Philosophical Naturalists. For the rest of the categories, there are no differences. Hence from this data, it would seem that Philosophical Naturalists are *not* any more supportive of science than are Christian Fundamentalists. The difference between the groups is not whether they value science or not, but whether scientific knowledge must be valued above other forms of knowledge (especially religious knowledge) and the extent to which scientific research should be regulated. Neither of which can reasonably serve as a litmus test for anti-science sentiments.

Figure 5: Interest in Science and TSSI Category Means for Philosophical Naturalists and Christian Fundamentalists (2002-2008)



Race = Science, Race & Gender  
 Intrst = Interest in Science  
 Epist = Epistemology  
 Aesth = Science & Aesthetics  
 Poly = Public Regulation of Science

Econ = Science & the Economy  
 For-All = Science for All  
 Envir = Science & the Environment  
 Heal = Science & Public Health

## Conclusion

Martin (1997, p. 239) in this journal argued that, “Science education and Christian education are not compatible if by ‘Christian education’ one means teaching someone to be a Christian.” To put it another way, according to Martin, being a Christian is not compatible with science, an opinion fortified by highly visible anti-evolutionism in some sectors of the Christian community. He and others such as Mahner & Bunge (1996) or Good (2001b) provide *logical* arguments for their opinion--but surely this question is an empirical one. It does not matter how pervasive the logical argument; it is only the data that count. For example, one could investigate the percentage of Christian college students with science majors. If the Martin hypothesis is true then the percentage should be significantly below the average for all students. One could also investigate the number of Christians who are in science occupations; and here one might count the Larson & Witham (1998) report in favor of the Martin hypothesis, but this study only involved a limited number of scientists and did not include the engineering, medical or agricultural professions that attract many Christian students. Moreover, the research done by Elaine Howard Ecklund amongst scientists suggests scientists have considerable interest in religion and spirituality

(Ecklund & Park 2009; Ecklund & Scheitle 2007).<sup>18</sup> How consistent is that with the Martin hypothesis?

We suggest that there are actually many empirical approaches to the Martin hypothesis and one can only speculate why he and others who share his opinion have not approached the issue scientifically. Our study addressed the Martin hypothesis via a study of science valuation in the public, where the subjects are preservice elementary teachers—people who are well educated in general but not greatly science-educated. The finding of this study is that there is *no* empirical corroboration for the suggestion that support for science is negatively associated with Christian orthodoxy or even Christian fundamentalism— hence, no empirical support for the suggestion that science and being a Christian are incompatible. As reported by Pew Research Center for the People & the Press (2009), Americans like science and it hardly matters what their religion is.

From our study and others, we conclude that anti-evolution sentiment is *not* indicative of anti-science sentiment; and, if anti-evolution sentiment is *not* indicative of anti-science sentiment, then it is surely a mistake to approach the improvement of the public's understanding of evolution with the assumption that anti-evolution sentiment and anti-science sentiment are linked phenomena, let alone synonymous. Such a conclusion does not diminish the challenge of creationism and anti-evolutionism, but it should suggest that “warfare” metaphors are not likely to be of much help. In recent years Americans have endured a political polarization dubbed the “Culture Wars” dividing the public along the lines of traditionalists and secularists (Bolce & De Mai, 2002; Orwi, 2004). Accusing people of being opposed to science because of their oppositional views on evolution is only going to fuel their feeling that there is indeed a Cultural War. There is a problem with creationism and anti-evolutionism in science education, *and it is possible to make the problem worse*. Rather, we suggest that the science education community pay more attention to how orthodox Christian students and teachers integrate knowledge of science and evolution, when integration occurs (e.g., Cobern 2007; or Miller 2003). Where evolution is rejected, rather than dismissing rejection as evidence of an anti-science attitude, the science education community should examine the reasoning processes and knowledge bases that objectors draw upon in support of their rejection of evolution while still remaining supportive of science in general. A teacher won't make any headway by refusing to understand the students, let alone by disrespecting them.

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<sup>1</sup> Our topic is one where terms such as fundamentalist, conservative or traditional are often used. We prefer “orthodox” with its rather uncomplicated meaning that orthodox Christians are those who adhere to the historical teachings of Christianity. Of course there are differences within the Christian church but there are core beliefs that no one can reject and still be considered orthodox (see Johnson 2003; Pelikan 2003). This point was made very well by C. S. Lewis in *Mere Christianity* (1943).

<sup>2</sup> While the USA has more than its share of anti-evolutionism, this phenomenon is not confined to the USA. See the 2007 Council of Europe report titled, “The dangers of creationism in education: Report, Committee on Culture, Science and Education” (<http://www.assembly.coe.int/Main.asp?link=/Documents/WorkingDocs/Doc07/EDOC11297.htm>).

<sup>3</sup> See [http://atheism.about.com/library/texts/white/bl\\_white\\_chapter01.htm](http://atheism.about.com/library/texts/white/bl_white_chapter01.htm) and [http://www.infidels.org/library/historical/andrew\\_white/Andrew\\_White.html](http://www.infidels.org/library/historical/andrew_white/Andrew_White.html).

<sup>4</sup> *A History of the Warfare of Science with Theology in Christendom*, i. 127-8. Edward Rosen first uncovered the spurious attribution to Calvin; see “Calvin’s Attitude Toward Copernicus,” *Journal of the History of Ideas* 21 (1960): 431-41.

<sup>5</sup> White apparently based the Wesley quote on a comment in Charles Woodruff Shields, *The Final Philosophy* (1877, p. 61). In a discussion of various theological opinions about life on other worlds, Shields notes that Wesley, “in a sermon on the VIIIth Psalm, after [William] Derham and [Christiaan] Huyghens had associated a plurality of worlds with revealed truths, termed that opinion the palmary argument [i.e., an unanswerable argument] of infidels, and declared he would doubt it, even though it were allowed by all the philosophers in Europe.” In the sermon in question, entitled “What is Man?” (a reference to Psalm 8:4), Wesley rejected not Copernicanism, but only “the plurality of worlds, a very favourite notion with all those who deny the Christian revelation,” partly on the basis of Huyghens’ telescopic observation “that the moon has no atmosphere” and therefore “no clouds, no rain, no springs, no rivers; and therefore no plants or animals.” It is quite a stretch to conclude from this, as White did, that Wesley opposed heliocentrism.

<sup>6</sup> *The Works of John Wesley*, ed. Albert C. Coulter, 23 vols. (Nashville: Abingdon, 1984), iii. 454-63, quoting 462. For a lengthy discussion of Wesley’s position on extraterrestrial life, see Michael J. Crowe, *The Extraterrestrial Life Debate, 1750-1900* (Cambridge: Cambridge University Press, 1986), 92-6; for his overall attitude toward science, see J.W. Haas, Jr., “John Wesley’s Views on Science and Christianity: An Examination of the Charge of Antiscience,” *Church History* 63 (1994): 378-92.

<sup>7</sup> In interesting example of alleged Evangelical influence in the USA is the concern in 2009 that Evangelicals unduly influenced the outcome of the popular TV show *American Idol* by voting in droves for specific contestants (McKay 2009).

<sup>8</sup> For example, questions about church structure and authority would easily separate Catholics and Protestants who otherwise responded conservatively to Barna and Gallup polling questions.

<sup>9</sup> The May 2010 Associated Press/Gfk Poll estimated that 38% of Americans self-identify as “born-again or evangelical Christian”. The same poll, the very next month, estimated the percentage at 42.

<sup>10</sup> One should be careful not to over-interpret these numbers, as they tend to obscure substantial differences within groups. See Keysar & Kosmin (2008) and The Pew Forum on Religion & Public Life (2008a). On the persistence of Americans’ belief in God, see The Pew Forum on Religion & Public Life (2008b).

<sup>11</sup> The term “fundamentalism” as applied to Christianity originates from *The Fundamentals: A Testimony to the Truth*, published by Baker Books in the early 20<sup>th</sup> century. The term then, and now as used in the CFBS, refers to: “the premise that there are essential doctrines of Christianity that should not in any way be set aside or tampered with, these doctrines are ‘fundamental’ to true Christianity. A fundamentalist in this sense of the word is one who upholds these doctrines without compromise.” See <http://www.xmission.com/~fidelis/>. However, in today’s world, the term “fundamentalism” has come to mean something quite different and almost always is taken as pejorative.

<sup>12</sup> See the Roper Center webpage ([http://www.ropercenter.uconn.edu/education/polling\\_fundamentals\\_intro.html](http://www.ropercenter.uconn.edu/education/polling_fundamentals_intro.html)) for a primer on modern day polling.

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<sup>13</sup> Item one reflects the Christian fundamentalist view of the Bible as inerrant. Item eleven represents a fundamentalist view of divine providence.

<sup>14</sup> We report both mean and median because the category data is skewed. We use the means for calculating correlations, but as the category medians provide a more accurate sense of the center for each category, we use medians in discussions about the subjects vis-à-vis the *Model*.

<sup>15</sup> Similar findings on preservice elementary teacher agreement on the importance of science for all and equivocation on gender issues were reported by Jesky-Smith (2002)

<sup>16</sup> Until an effect size reaches 0.3 ( $r \sim 0.55$ ), we do not consider the correlation to be of much practical value.

<sup>17</sup> We did not include the Science & Religion category or the CFBS since our distinguishing items were drawn from these two.

<sup>18</sup> Also see Brown (2003) and Falcão (2008).